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The Effect of Concentration on the Performance of Caged Leghorn Hens in Hawaii

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INTRODUCTION

Results of several studies conducted to determine the extent to which layers can be concentrated in cages without seriously affecting their productive performance have recently been reported. Bell (1965) compared the performance of birds housed at the rate of two and three birds in 10x16-inch cages and reported that the hen-day egg production of two birds and three birds per cage was 70.6 and 68.6 percent, respectively. He found that death loss due to pick-outs or prolapse was greater among the more crowded birds. Davis (1966) studied the performance of birds housed at

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four different densities and noted that the production rate declined and mortality increased as density and number of birds per cage increased. Rooney *et al.* (1965) reported that egg production of two birds per 12x18-inch cage was 74.3 percent while that of three birds per cage was 74.4 percent. Two hens per cage suffered a 1.4 percent mortality loss due to pick-outs or prolapse, compared with a 7.4 percent loss among three hens per cage.

These experiments show that crowding cage layers under temperate conditions usually results in a slight decrease in egg production and an increase in mortality. However, the resulting increase in farm capacity may more than compensate for a decrease in individual bird performance.

Information is lacking on the effect of crowding cage layers under semitropical conditions. If performance is not seriously affected by crowding the birds, producers will be able to accommodate more birds in existing cage facilities and thus increase farm capacity. This would enable the producer to make more efficient use of the limited land area available to him, especially on Oahu which is the center of Hawaii's economy.

A popular type of laying cage in Hawaii is 12 inches wide and 16 or 18 inches deep and is commonly used to house two birds. The present study was designed to compare the performance of Single Comb White Leghorn pullets confined in 12x18-inch laying cages at the concentration of two and three birds per cage.

MATERIALS AND METHODS

Pullet chicks of a locally available commercial strain were reared under similar conditions of management up to 25 weeks of age (February 1, 1965) after which they were transferred to 12x18-inch laying cages at the rate of two or three birds per cage. They were kept in these cages during the 52-week experimental period. Two double rows of back to back cages were used. In each row there were 80 cages which were divided into 2 blocks of 30 cages each plus 20 central cages used for housing birds for replacement. The treatments were randomly assigned within each block.

The number of birds in each laying cage was kept constant throughout the experiment. Dead or culled birds were replaced by birds kept under the same conditions of management and concentration.

During the experiment, the birds were given feed and water *ad libitum* and provided with 14 hours of light per day.

Data on hen-day egg production, egg weight, egg quality, shell thickness, incidence of blood and meat spots, incidence of cracked, checked and dirty eggs, feed efficiency (pounds feed/dozen eggs), and mortality were obtained. The birds were weighed by replicate at the beginning and at the end of the experiment.

The daily maximum and minimum temperatures and relative humidity were recorded in the poultry house throughout the period of the experiment.

The means of each parameter of all replicates of each treatment were calculated and used for further analysis. The data were analyzed by analysis of variance (Snedecor, 1956). The percentage data except that of egg production were transformed using the Arcs in transformation.

RESULTS AND DISCUSSION

Hen-day Egg Production

The mean hen-day egg production per 28-day period is illustrated in Figure 1. The average annual egg production for two birds per cage was 67.2 percent and for three birds per cage 65.9 percent (Table 1). This 1.3 percent difference in hen-day egg production was not significant statistically. Similar results were reported by Bell (1963) and Rooney *et al.* (1965) who found only a small decrease in egg production among the birds housed at the rate of three birds per cage as compared to two birds per cage.

The average weekly maximum temperature in the poultry house ranged from a high point of about 84°F. during September, 1965, to about 75°F. at the end of January, 1966. The average minimum temperature ranged from 77°F. to 68°F. The maximum relative humidity in the house during most of the time averaged nearly 100 percent, whereas there was much fluctuation in the minimum relative humidity which ranged from 60 to 90 percent.

Egg Weight and Egg Quality

The average weight of eggs laid by two and three birds per cage was 59.5 and 59.4 gm, respectively (Table 1). This difference was not statistically significant. These results are in agreement with those of Quisen-

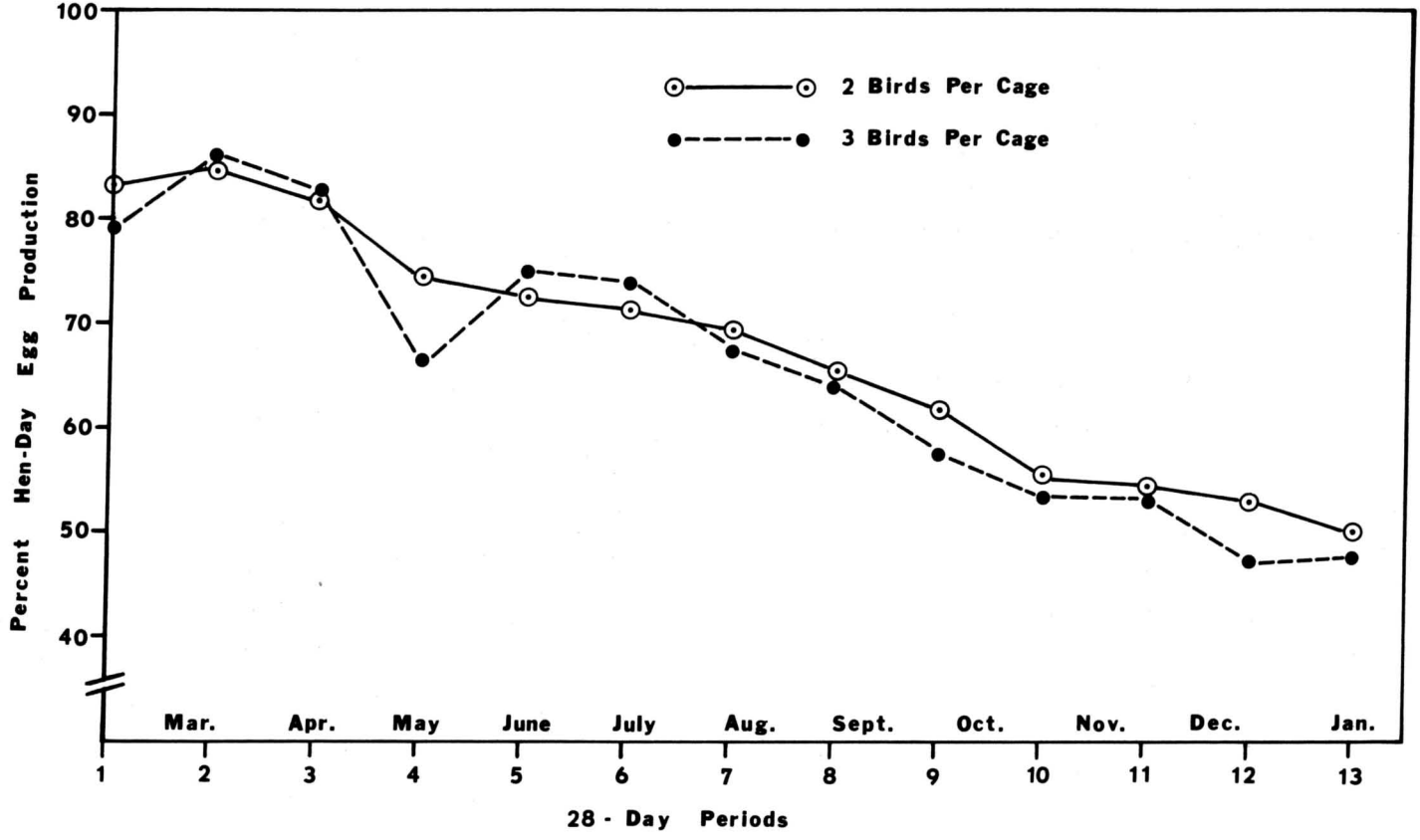

FIGURE 1. Mean hen-day egg production of White Leghorn hens caged at two different densities from 25 to 77 weeks of age.

TABLE 1. Mean performance data of layers in 12x18-inch cages

Trait	Treatments	
	2 birds per cage	3 birds per cage
Egg production (%)	67.2	65.9
Egg weight (gm)	59.5	59.4
Haugh Units	75.2	75.3
Shell thickness (1 unit = 0.001 inch)	12.3	12.2
Blood spots (%)	1.2	1.1
Meat spots (%)	2.5	2.3
Cracked eggs (%)	1.5	3.5*
Body checked eggs (%)	2.9	7.4**
Dirty eggs (%)	2.4	2.9
Feed required to produce a dozen eggs (lb)	4.37	4.23*
Gain in body weight (lb)	0.60	0.69
Mortality (%)	5.4	10.8*
Culling rate (%)	13.3	12.5

*Significantly different from 2 birds/cage at 5% level of probability.

**Significantly different from 2 birds/cage at 1% level of probability.

berry (1964) who reported no differences in egg weight when birds were housed at varying densities.

Albumen quality was measured in Haugh Units. The mean Haugh Unit score of eggs laid by two birds per cage was 75.2 and for three birds per cage was 75.3, as shown in Table 1. The difference was not significant. Wilson *et al.* (1964) compared the performance of two and three birds in 12x18-inch cages in California and reported that Haugh Unit scores were not affected by the number of birds per cage.

Average shell thickness was 12.3 and 12.2 (1 unit = 0.001 inch) for eggs laid by two birds per cage and three birds per cage, respectively, as shown in Table 1. The difference was not significant. Similar results were reported by Wilson *et al.* (1964).

There were no significant differences in either the percentage of blood or meat spots among eggs laid by birds housed at the rate of two and three birds per cage.

The incidence of cracked, body checked, and dirty eggs was higher among eggs laid by birds housed at the rate of three birds per cage (Table 1). Differences in the number of cracked and body checked eggs were significant. Wilson *et al.* (1964) reported that the incidence of body checked eggs was higher among birds housed at the rate of three birds per cage as compared to two birds, but the difference was not significant. Cage density did not adversely affect albumen quality, shell thickness, or the incidence of blood and meat spots.

Feed Efficiency and Gain in Body Weight

The pounds of feed required to produce one dozen eggs was 4.37 for two birds per cage and 4.23 for three birds per cage, as shown in Table 1. The difference was significant ($P < .05$). Davis (1966) reported that birds with the smallest cage area required less feed per dozen eggs produced, possibly because the birds housed at lower concentrations wasted more feed. Similar results were obtained in the present study; however, feed wastage did not appear to be involved.

The average gain in body weight for two birds per cage and three birds per cage was 0.60 pound and 0.69 pound, respectively (Table 1). This difference was not significant and was probably due to the more restricted movement and slightly lower production of the crowded birds.

Mortality and Culling Rate

The mortality rate during the 52-week experimental period for two birds per cage was 5.4 percent and for three birds per cage was 10.8 percent (Table 1). The difference was significant ($P < .05$). Bell (1965) and McCluskey (1962) reported an increase in mortality with an increase in the density of birds due mainly to pick-outs or prolapse. In the present study, although mortality in the three birds per cage treatment was twice that of two birds per cage, the incidence of pick-outs or prolapse was negligible.

Birds which were out of production and appeared weak and unthrifty were removed and replaced by birds housed under the same management conditions and density. The culling rate in the case of two birds per cage was 13.3 percent while in the case of three birds per cage it was 12.5 percent (Table 1). The difference was not significant statistically.

Application of Results

Income from the sale of eggs, excluding cracked eggs, was calculated over the cost of pullets and feed for both densities of birds. The cost of pullets at the age of 25 weeks was taken as $2.25 each. The cost of feed was $110.00 per ton, the average price charged to the University of Hawaii Poultry Farm for the layer ration. Mortality and culling rates were taken into account because dead birds as well as weak and unthrifty birds were replaced during the course of the experiment. The figures are presented in Table 2.

The income over pullet and feed cost from maintaining 240 birds in 120 cages was $787.56 or $3.28 per bird, whereas maintaining 360 birds in the same number of cages returned $1,089.80 or $3.03 per bird, an increase of $302.24. Thus the efficiency of land and house use was increased by crowding the birds, although the income per bird was less.

In view of these encouraging results, studies are currently being initiated to determine whether birds can be further concentrated in 12x18-inch laying cages without seriously depressing their performance.

TABLE 2. Income over pullet and feed cost of layers in 12x18-inch cages

Item	Treatments			
	2 birds per cage		3 birds per cage	
Income from sale of marketable eggs		$2,606.47		$3,760.58
Initial cost of pullets	$ 540.00		$ 810.00	
Replacement cost of pullets	101.25		189.00	
Cost of feed	1,177.66		1,671.78	
Total cost		1,818.91		2,670.78
Income over pullet and feed cost		$ 787.56		$1,089.80
Income per bird over pullet and feed cost		3.28		3.03

SUMMARY

Confining three birds in 12x18-inch laying cages generally depressed individual bird performance below that of two birds per cage, but concentrating the birds increased farm capacity which more than compensated for the decreased performance.

Mean hen-day egg production for two birds and three birds per 12x18-inch cage was 67.2 and 65.9 percent, respectively. The 1.3 percent lower production for three birds was not significantly less than that obtained for two birds per cage.

There was no significant difference in egg weight or egg quality as measured in Haugh Units, and shell thickness of eggs laid by birds housed at the rate of two or three birds per cage. Increasing the number of birds from two to three in the 12-inch-wide cages did not adversely affect the incidence of blood and meat spots.

The number of cracked and body checked eggs was significantly greater in the case of three birds per cage as compared to two birds per cage. More dirty eggs were produced by the more crowded birds, but the difference was not significant.

The feed required to produce one dozen eggs for two birds per cage was 4.37 pounds while in the case of three birds per cage it was 4.23 pounds. This difference was significant.

The average gain in body weight during the experimental period for two birds and three birds per cage was found to be 0.60 pound and 0.69 pound, respectively, but the difference was not significant.

The mortality rate for two birds per cage was 5.4 percent and for three birds per cage was 10.8 percent. The difference was significant. There was no significant difference in culling rate among birds housed at either concentration.

Income over pullet and feed cost from maintaining 240 birds in 120 cages was $787.56, whereas maintaining 360 birds in the same number of cages returned $1,089.80, an increase of $302.24.

The results of this study indicate that by crowding birds poultrymen may make maximum use of existing facilities without investing in additional housing if expansion is contemplated.

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